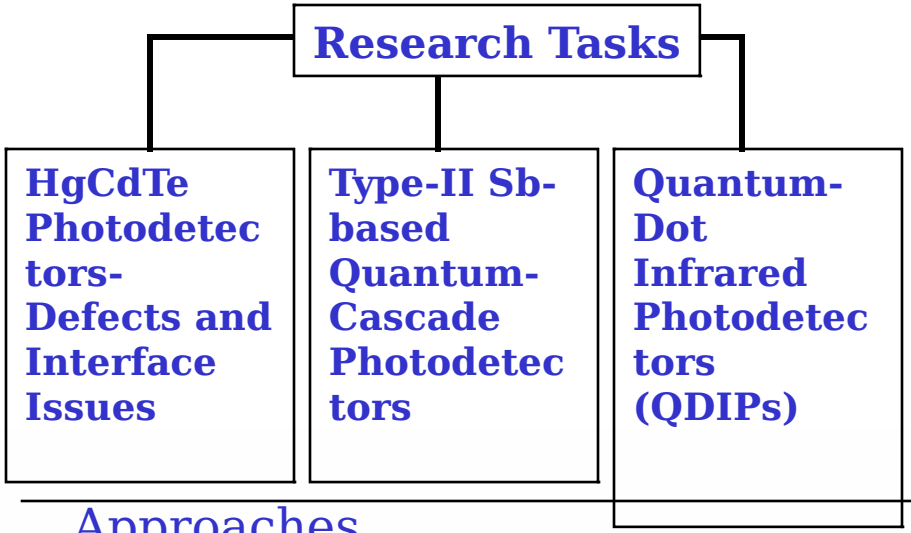
# Fundamental Research on Infrared Photodetectors

## University of Illinois

**MURI, year started: 2001** **December 2001**




Objectives

- **Investigate defects in HgCdTe photodetectors**
- **Design and fabricate novel antimony-based type-II quantum-cascade photodetectors**
- **Fabricate strain-balanced quantum-dot infrared photodetectors (QDIP) using III-V material systems**

## Approaches

- **Identify structure and point defects (TEM, XPS) and optical characterization of defects (PL, FTIR) in HgCdTe systems**
- **InAs/InGaSb type-II superlattice photodetector design and fabrication by MBE**
- **Strain-balanced multiple QDIP structure:**
  - **Eliminate defects through strain-balanced QDIP structures using tensile**

## Research Partners

- **University of Illinois at Urbana-Champaign**
- **University of Texas at Austin**
- **Collaborations with Columbia University and University of Illinois at Chicago**

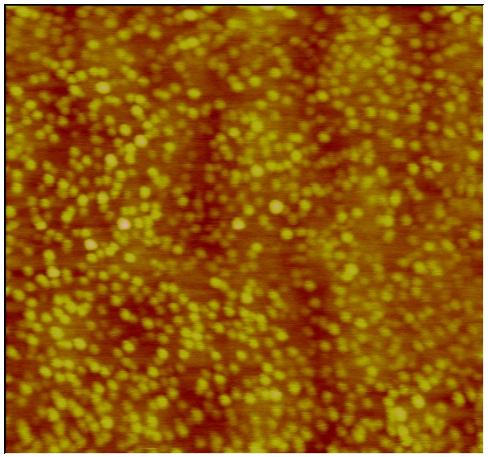
## Transition Partners

- **DRS IR Technologies, HRL Labs, Appl. Optoelectronics**
- **ARL, Army Center for Night Vision & Electro-Optics, JPL, Sandia National Lab**

**Budget: $2M for 5 years**

# Quantum Dot Infrared Photodetectors (QDIPs)

MURI




AFM image (1x1 μm) of InAs QDs on GaAs

## Objectives

- Investigate the growth process and its effects on QD size and density
- Study the effects of barrier thickness and material on QD properties (barr material: GaAs, InGaP)
- Ultimately use these results to gro high-performance QDIP

## Approach

- Use solid-source molecular beam epitaxy (SSMBE) for crystal growth
- Material analysis techniques: AFM, TEM, X-ray diffraction, FTIR analysis, and photoluminescence (PL) measurements
- Use tensile strained barrier materials to compensate the compressively strained QDs to allow for many QD layers in photodetector

## Accomplishments

- Achieved successful formation of InAs QDs on GaAs substrates (AFM, TEM and PL)
- Demonstrated QD heterostructures with different barrier materials (PL and x-ray)
- Characterized str of multiple QD layers (x-ray and TEM)

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